Moyamoya Disease in an Infant With Autonomic Dysfunction: Angiographic and MRI Findings

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Abstract

An infant with persistent Harlequinism went on to develop a hemiparesis secondary to Moyamoya disease at 2½ months of age. The sympathetic nervous system is proposed to be an etiologic factor in the pathophysiology of Moyamoya disease as well as Harlequinism. This is one of the youngest patients reported in the English literature with Moyamoya disease and the only report of the coexistence of Moyamoya disease and atypical Harlequinism. Magnetic resonance imaging led to the diagnosis, which was confirmed by cerebral angiography. (*J Child Neurol* 1988;3:110–113).

Toyamoya disease ("puff of cigarette smoke drifting in the air") is an uncommon clinical and pathologic entity characterized by occlusion of terminal portions of the internal carotid arteries. Although the exact etiology is uncertain, there is evidence to support autonomic dysfunction as a contributing factor. We have recently used both angiography and magnetic resonance imaging (MRI) to evaluate one of the youngest patients with Moyamoya disease reported in the English literature. This patient also had other findings of autonomic imbalance including supraventricular tachycardia and atypical Harlequinism. Harlequinism is a rare condition consisting of a red, mottled appearance of the dependent half of the body of a newborn when laying on his or her side, with a sharp line of demarcation at the midline separating these changes from the normal skin coloring of the nondependent side. This skin coloring change may occur alternately in each side as the infant changes position. It is thought to be related to aberrant autonomic regulation of blood

vessels and it is usually a transient phenomenon in the newborn.²

Case Report

The patient is a white female born after a full-term, uncomplicated pregnancy by spontaneous vaginal delivery. Birth weight was 3500 g. Meconium staining, an occasional irregular heart beat, and mild postnatal hyperbilirubinemia requiring phototherapy were noted, as was red and purple mottling of the left half of the body. She was otherwise normal and was discharged from the hospital.

At 1 month of age, follow-up examination revealed multifocal atrial tachycardia, and she was admitted for evaluation. Fluoroscopy demonstrated normal heart size and pulmonary blood flow. Digoxin therapy was begun. The Harlequin-type skin mottling on the left half of her body was unchanged, and otherwise her examination was normal.

At age 2½ months, the patient was readmitted with the new onset of left hemiparesis, right gaze preference and poor tracking, which had developed insidiously over four days of affliction with a flu-like illness. Her head circumference was 40 cm, 50th percentile. The left body mottling was more cyanotic than red at this time, and the left extremities were cold. Heart rate and rhythm were normal and the infant was still taking digoxin.

A noncontrast computed tomographic (CT) scan of the head revealed increased density of the entire right hemisphere, with focal areas of low density in the frontal and deep parieto-occipital white matter. With contrast, the entire right hemisphere enhanced, suggesting either blood flow asymmetry ("luxury perfusion") or abnormal vascularity. The ventricles were moderately enlarged. Electroencephalogram revealed diffusely decreased voltage in the right hemisphere. Echocardiogram was normal.

At age 4 months, the patient was readmitted with the

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onset of a seizure disorder. Harlequin discoloration was still noted in the left trunk and intermittently in the left extremities. Head CT scan demonstrated atrophy of the right hemisphere presumed to be secondary to infarction. Electroencephalogram showed low voltage in the right hemisphere and sharp forms in the left lateral hemisphere.

At age 12 months, her head circumference was 41.5 cm, two standard deviations below the 3rd percentile. She had no purposeful movement due to severe spastic quadriparesis (left greater than right) but could follow visually and smiled responsively. There were no neuroectodermal markings. Tine test was negative.

An MRI scan was therefore obtained which demonstrated bilateral hemispheric atrophy (right greater than left), enlarged cerebral ventricles, absence of flow in the carotid arteries bilaterally, and multiple small vessels in the area of origin of the left middle and anterior cerebral arteries, as well as within the basal ganglia (Figures 1 and 2). Moyamoya disease was suspected, and neurosurgical consultation was obtained regarding the possibility of performing an extracranial-intracranial bypass procedure. In order to better define the collateral flow, a cerebral angiogram was performed.

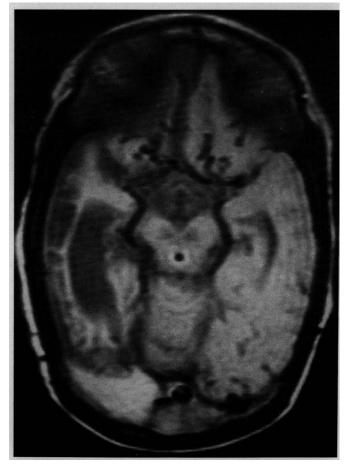


FIGURE 1 MRI scan (TR 2000/TE 30) demonstrating enlarged right temporal horn and Moyamoya vessels in middle and anterior cerebral territories bilaterally (age 12 months).

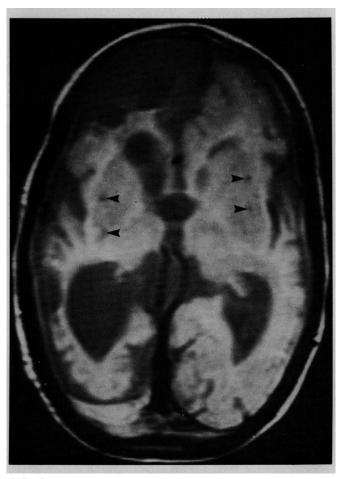
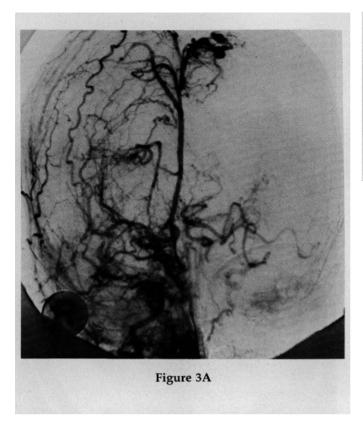


FIGURE 2 MRI scan (TR 2000/TE 30) demonstrating basal ganglionic collaterals (arrows).

A right common carotid injection demonstrated preferential filling of the right external carotid artery with retrograde filling of the supraclinoid segment of the right internal carotid artery. A prominent anterior cerebral (azygous) artery supplied both anterior cerebral artery territories. In turn, vessels from the right anterior cerebral artery filled the right middle cerebral territory, since both horizontal segments, as well as the posterior cerebral artery, were occluded. The left ophthalmic artery filled from the right external carotid artery and subsequently supplied the lenticulostriate artery and at least the proximal middle cerebral artery. The right superficial temporal and occipital arteries may have also helped to supply some of the cortical vessels (Figure 3).

The diagnosis of Stage V-VI (Suzuki classification) Moyamoya was confirmed. In light of the extensive extracranial-intracranial blood flow, we felt that the patient would not benefit from surgery.

At last follow-up, she was 32 months of age. Her heart rate had been normal for two years and digoxin had been discontinued four months previously. Bowel and bladder function were normal for an infant. Head circumference was 42 cm, 4 standard deviations below the 3rd percentile. She continued to have severe spastic quadriparesis, but could



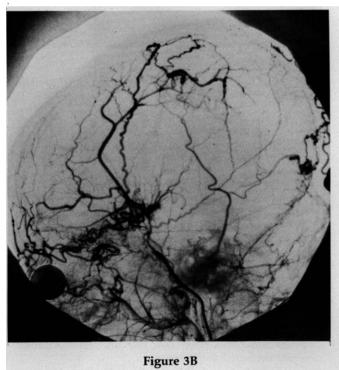


FIGURE 3
Anterior-posterior (A) and lateral (B) cerebral angiograms demonstrating multiple extracranial-intracranial anastomoses in the middle cerebral artery territory with occlusion of the right internal carotid artery.



FIGURE 4 Left truncal mottling with midline demarcation (Harlequinism).

reach with her right hand and propel herself in a walker. Her left body mottling persisted (Figure 4), especially truncally, where a sharp line of demarcation remained in the midline anteriorly. Her feet and often her hands were red or purplish but blanched easily. She had never been noted to sweat, but she teared readily with crying.

Discussion

Moyamoya is a rare disease of uncertain etiology. Other processes such as radiation vasculopathy, neurofibromatosis and tuberculous arteritis can result in a Moyamoya angiographic pattern if the supraclinoid portion of the internal carotid artery is involved, and these should be included in the formal differential diagnosis. 4 Moyamoya is more commonly seen in those of Japanese descent. Our patient presented with a right cerebrovascular accident presumably secondary to ischemia or occlusion of her right middle cerebral artery at age 21/2 months. This is one of the youngest documented cases of Moyamoya disease in the English literature and the only one, to our knowledge, that has other signs consistent with autonomic dysfunction. Magnetic resonance imaging proved to be a noninvasive screening test for the disease process, as it provided an alternate means of imaging blood flow. This has been recently described by Fujisawa et al.⁵ The diagnosis in this case was confirmed by angiography.

Various etiologies of Moyamoya have been proposed, many of which infer an immunologic vasculitis as evidenced by a history of recurrent infections (usually head and neck) and deposition of immune complexes into the vascular walls. The immune complexes are thought to be responsible for the histopathologic findings of "eccentric and laminated hypertrophy of the intima, abnormal tortuosity and duplication of the internal elastic laminae, and thinning of the media" in the distal internal carotid ar-

teries. This, in turn, causes stenosis of these vessels and results in the formation of collaterals.

Suzuki has performed a series of experiments implicating the autonomic nervous system as a pathogenic factor.¹ He found Moyamoya-type vascular changes in dogs sensitized with heterologous serum and was able to demonstrate that immunologic complexes had been deposited in the vascular walls. Suzuki proposed that neck infections may stimulate the superior cervical ganglion in a retrograde fashion (Reilly phenomenon⁷), thereby increasing intimal permeability. This would allow circulating immune complexes to be deposited in the vascular walls and cause the pathologic changes of Moyamoya disease.

Yamada reported the development of Moyamoya disease in 4-year-old monovular twins. Both he and Isler suggested that the development of the collateral Moyamoya vessels may begin in the prenatal period.

The fact that our patient had persistent and atypical Harlequinism and supraventricular tachycardia suggest that she may have autonomic dysfunction on a developmental basis. Such autonomic dysfunction may explain the early appearance of her Moyamoya disease.

Acknowledgments

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